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Author

Boudreau, Gordon W.

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FACTORS RELATING TO ALARM STIMULI IN BIRD CONTROL

GORDON W. BOUDREAU, Director, Wildlife Technology, Paicines, California

I'm sure all of you have often heard of bird control methods which were successful in one place and failures elsewhere. Perhaps you have experienced these results yourself. Quite often, bird control apparatus or concepts are condemned as failures when actually other factors are responsible. Today, I shall explain some of the reasons these discrepancies occur.

My observations, over a period of 15 years, reveal that birds' responses to alarm stimuli varies with environmental conditions, clocktime, physiological requirements, social structure, species, and other factors. All of the observations reported herein were made under natural conditions while researching methods to reduce bird depredations in agricultural crops, and to eliminate bird collisions with aircraft in or near airports and air bases. These problems have not been widely publicized but nevertheless are very real and, at times, quite serious.

Birds receive most of their information through the eyes and the ears, and these sensory mechanisms have been well studied. The avian tactile (touch) sense has received little attention and this may prove to be another important channel of information. The other two senses, smell and taste, are regarded by most authorities as being less well developed. Taste, however, is important to birds in that it allows them to discriminate between preferred foods and, in some species, to detect minute traces of foreign material, such as toxicants. In this paper, however, only visual and acoustic alarm stimuli are discussed.

ALARM STIMULI

What is an alarm stimulus?

An alarm stimulus is defined as a sight or sound which elicits an escape response from the recipients. The responses are usually manifested by efforts to evacuate the area or to attain safe cover. A few bird species freeze in place as a survival recourse, and with these, perfection of camouflage is a contributing factor.

An alert response is merely a low level alarm response in which the birds are alerted but remain in place or slowly move away. Whether an alarm stimulus elicits an alarm or an alert response depends chiefly on the proximity of the stimulus.

Avian and terrestrial predators usually constitute the alarm stimuli observed in nature, and to a bird, humans are bipedal predators.

Any strange sight or sound often elicits initial startle responses which resemble alarm responses but differ in that birds quickly habituate to these stimuli. Birds do not readily inure to valid alarm stimuli unless they are incessantly exposed to them with relatively little danger to themselves. (Boudreau 1968).

Unless otherwise noted, the acoustic stimuli mentioned in this paper are the target species' natural alarm sounds, reproduced on tape, and projected at the birds.

ALARM SUSCEPTIBILITY FACTORS

Environment. Environmental conditions are important influences in birds' susceptibility to alarm stimuli. Birds of the open prairie and fields, such as Horned Larks, Eremophila alpestris; Meadowlarks, Sturnella sp.; etc., rely mainly on visual information, as do pelagic species. Forest and brush species depend largely on acoustic warnings from conspecifics, particularly if they are a gregarious species. Numerous species, however, will not respond to acoustic warnings until they have confirmed the information visually.

A bird's sensitivity to alarm stimuli is closely related to its vulnerability to attack and is proportional to its distance from safety. For example, House Finches or linnets, Carpodacus mexicanus, readily respond to reproductions of their alarm sounds when they are

feeding on the ground or in vineyards or orchards. After they attain the safety of a power line, however, the same sound moves them, but only when it is projected at greatly increased intensity, indicating that their sensitivity drops to very low levels once they feel they are safe. This same behavior pattern is observed with many other Fringillids.

An interesting example of environmental influence occurred on the rocket sled test track at Holloman Air Force Base, New Mexico. The track is similar to a railroad track but is secured atop concrete walls and is elevated about 73 cm. above ground level. The track is oriented north and south. A flat bottom trough, 65 cm. deep, separates the two rails and is used as a water reservoir for braking the rockets. After the water is drained off numerous small puddles remain which attract all the birds in this desert habitat. My observations were made in January, 1971, when the track was frequented mainly by Horned Larks and House Finches. When the birds were down in the trough, drinking or bathing, their visibility was limited to north, south, and vertical, and under these conditions they were denied visibility east and west. Brief reproductions of these species' alarm sounds never failed to elicit instantaneous responses when the birds were down in the trough. The birds immediately rose from the trough and flew to more open perches for better visibility. The same sounds, projected toward birds on the open ground nearby, brought responses in 80% of the projections and, with the Horned Larks, the responses were often delayed from three to five seconds.

These results are interesting in that they demonstrate the high level of sensitivity to alarm stimuli under unfavorable environmental conditions. They also revealed, in the Horned Lark, an ability to suddenly shift their reliance from visual receptors to acoustic sensory mechanisms for survival.

Another example of environmental influence may be observed when one attempts to evict birds from their established night roosts. Birds are careful to select night roosts that provide the ultimate in safety and comfort. Consequently, they are reluctant to leave these places, and here, their sensitivity to alarm stimuli drops to low levels. The same birds will readily respond to visual and acoustic stimuli in daylight away from the roost (Boudreau 1967). In some species, however, visual neural inhibitors prevent the birds from flying in darkness.

Clocktime. Observations in the field reveal a cyclic pattern in birds' susceptibility to alarm stimuli, which is related to the time of day. These cycles closely parallel the results reported by Schwab (1968) in susceptibility to toxicants. In both instances sensitivity is highest early in the morning and gradually decreases toward evening. In crop depredation studies I found Starlings, Sturnis vulgaris; Red-winged Blackbirds, Agelaius phoeniceus; and House Finches, often ignored alarm stimuli in the early evening hours while readily responding to the same stimuli during the day. The morning and evening tests were made with different flocks which precluded any incipient habituation to the stimuli. I attribute this behavior to their susceptibility cycles and also to the necessity of feeding well prior to roosting. It is possible that these susceptibility cycles may be related to birds' diurnal rhythms, which have not yet been well studied.

Physiological Requirements. Hunger and thirst often induces an audaciousness in birds which they do not ordinarily display. Band-tailed Pigeons, Columba fasciata, are a good example of this. In several experiments I was successful in repelling a flock of 75 inveterate pigeons from a choice Olallie berry field during the day, using both visual stimuli and noises. An Olallie berry is a boysenberry-blackberry hybrid relished by many bird species. The pigeons remained in the vicinity during the day and little feeding was observed. Specimens collected at various times during the day had little or no crop contents, indicating a condition of hunger late in the afternoon. About 30 minutes before their normal roosting time the pigeons descended into the berries and engaged in a feeding frenzy during which they ignored all efforts to evict them, including shotgun fire at close range. Several times I approached to within four meters of them before they moved short distances and resumed feeding. My assistants collected several specimens leaving the berries and flying to the nearby roost, and all had from 12 to 15 berries in their crops. These observations indicate it is imperative that Band-tails, at least, must enter the roost with full crops otherwise they may not survive the night in adverse weather. This degree of temerity, however, is not displayed by all species, but a reluctance to respond to normal alarm stimuli, and abnormal persistence in returning when evicted, is usually observed in feeding birds just prior to leaving for the night roost.

Birds frequenting isolated sources of food and water often become quite refractory to alarm stimuli unless the predator is very near, indicating that hunger and thirst take precedence over survival. In other words, the birds are willing to take calculated risks to obtain food and drink. My observations reveal that hungry birds do not respond as readily as do well fed individuals.

Social Structure. Gregarious species are much more susceptible to acoustic alarm stimuli than non-gregarious birds. Furthermore, gregarious species usually have well developed alarm sounds to which they readily respond.

Another interesting observation is that large flocks of a species respond much better than smaller groups and, in fact, groups of five or less often fail to respond. This is particularly noticeable in House Sparrows, Passer domesticus; House Finches, Band-tailed Pigeons, and certain species of blackbirds. Many times I have failed to elicit responses to alarm sounds from groups of three to five birds. After these were joined by several others the entire group always responded to the next sound projection. This behavior suggests that some individuals are more timid than others and respond more readily, and these trigger the response of the others in the group. Conversely, some individuals are more refractory and require the visual stimulus of a departing timid bird to reinforce the acoustic stimulus. The odds that a small group of birds will include a sensitive individual appear to be about six or seven to one. Obviously, the larger the flock the more sensitive individuals it will contain and the better will be the response. This applies to all alarm stimuli.

Nesting pairs are usually very reluctant to abandon their nests and territories in response to reproduced alarm sounds. Yet, the same species responds very well when they form into flocks later in the year. Robins, Turdus migratorius, are a good example of this. Thus, a seasonal factor is often involved in birds' susceptibility to alarm stimuli.

Incidentally, I might mention that in two experiments, nesting starlings did abandon their nests and eggs after exposure to repeated projections of their alarm sounds.

Species. In working with birds' alarm sounds one quickly learns that some species respond very well, some moderately so, and some not at all. Species which are vulnerable to predation respond best. I use the size of the egg clutch as one indicator of the response to be expected. In general, species with large egg clutches are more vulnerable to predation and respond more readily. The Laysan Albatross, Diomedea immutabilis, which lays only one egg per year, has no known alarm sound, and ignores even humans. Like many other pelagic species they have few if any natural enemies and consequently they have never developed a fear complex. Conversely, many gallinaceous species such as quail, which lay eight or more eggs, have many enemies, use well defined alarm sounds and readily respond to them.

Other Observations. In addition to my studies with alarm sounds, I have investigated responses to other bird sounds such as feeding sounds and territorial songs. In all cases, the factors outlined above, plus several others, must be considered when evaluating experiments. A well fed bird cannot be expected to respond to its feeding sound, and, with many species, males will not be attracted to reproductions of their territorial songs except during their breeding season.

It follows then, that experiments with a specific alarm stimulus must be conducted at various times and under different conditions to arrive at definite conclusions.

I am hopeful the factors described above will be helpful to present and future investigators in evaluating responses to animal sounds.

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STARLING CONTROL IN SONOMA COUNTY

HARRY F. MC CRACKEN, Agricultural Commissioner, Sonoma County Department of Agriculture,
Santa Rosa, California

The European Starling, *Sturnus vulgaris*, began the invasion of California from the north and east as early as the late 1930's. In the winter of 1954, 20,000 of these birds were reported spending the winter in or near the Sonoma, Mendocino Coast. Then in 1961, Walter Ball, at that time the Chief of the Bureau of Rodent and Weed Control in Sacramento, in a talk to the Agricultural Commissioners at the Spring Convention, stated Starlings had been reported from nearly every section of California. In reviewing Walter Ball's paper given at that time, it is somewhat surprising how accurately the predictions he made have come true.

It was about this time that we in Sonoma County began to observe Starlings nesting in Oak trees in the Santa Rosa Plains. So in cooperation with the State Department of Agriculture and the University of California at Davis, we began a small trapping and banding program, but mostly observation and study. It soon became apparent that we were faced with two different situations; the migrating Starling and the resident population.

Migration of Starlings into the County commences towards the end of October. Many, many thousands of birds will begin moving into our area. However, as early as September 1st, flocks of Starlings will suddenly appear in the vicinity of our vineyards.

These September flocks are rather small in size from several dozen to several hundred birds. They appear to be very thorough and persistent in scouting and testing ripening wine grapes. Through years of observations we have good reason to believe that these birds, and especially resident Starlings, will act as decoys and call in later arriving migrants.

Then about the 1st of March, they move North. However, many thousands still decide that they like the area to live in and nest. We were finding that they were nesting in woodpecker holes in Oak trees and could be the real trouble makers to our crops. If not controlled, they could cost our farmers untold damage.

At the request of the Farm Bureau in 1964, the Sonoma County Board of Supervisors passed a resolution instructing the Agricultural Commissioner to take whatever action necessary to control and suppress the European Starling.

The birds were usually nesting in trees adjacent to dairies where there was an abundant supply of high protein food for their young. Both sexes were observed making very frequent trips from manure piles in fields to the nests. It was also found that each pair had at least two and some had three hatches during the spring consisting of five to seven birds in each hatch.

The news media of the County gave a great deal of publicity to the problem; so the public was well aware of the hazards of these birds when control methods were started. Not having a great deal of experience in controlling Starlings at that time and finding that only certain areas were being invaded, the County started a shooting program to control the adult birds. Some of the inspectors became excellent marksmen and the adult population was kept to a minimum; much was learned about preferred nesting areas in Sonoma County.

Also, modified Australian Crow Traps were put into use and it was soon learned that the young fledglings could be readily trapped if the traps were placed in the proper areas using good decoys and abundant cull fruit to attract the young birds. However, these trapped birds also provided a ready meal for any predator in the area and as soon as the predators started killing the trapped birds, the trap immediately became useless until the harasser was captured. In many cases, the nervous and injured decoys will have to be removed and replaced by new decoys.

We purchased live Havahart traps and placed out with each Australian Crow Trap. When the animals were caught, they were either destroyed or relocated in other areas of the county. These predators mainly consisted of cats, foxes, skunks, coons, hawks and other small animals. Also, despite the information given out by the news media, we ran into the

problem of man predators. We have had traps completely destroyed "by ax," traps upended and holes cut in the wire by individuals that believed we were out to exterminate the species.

We have found that by keeping the resident Starlings under control, the resident birds are actually on the decrease; by the 4th to 5th year a noticeable decline of resident nesting adults was apparent. The attrition losses of the adult birds may be attributed to this factor.

In studies by Brina Kessel, she found that under natural and unmolested conditions, at least 93% of birds fledged in one locale usually returned to nest within one mile of their original nesting site. So control of these resident juveniles is absolutely necessary if one is to keep the future population at a minimum.

We have been experimenting with different types of poison baits; mainly, D.R.C. 1339. We have used this on every type of material imaginable; however, we have not yet convinced ourselves that this is a good method of controlling the Starling.

At the present time, we are using 10 modified crow traps which are 6' x 8' in size and we have one large trap mounted on a trailer which is 8' x 20'. This spring we are purchasing another large trailer so we shall have two such mobile traps in operation.

We have found that when we find damage being done or spot a large infestation of birds, we can readily move these large trailers into the area and normally within a week, we can capture practically all the young fledglings.

In operating these traps, we have to be very particular and careful that the trapped birds that we do have in the cages are readily cared for. We hire a student in early summer and throughout the summer his job is to feed and water the birds that are trapped and take the excess and dispose of them.

For the past several years we have supplied the University of California at Davis quite a number of birds for research work. We also have several farmers that have taken the plans of the modified Australian Crow Trap and have built traps of their own. However, these we check normally at least once a week to make sure they are operating it properly and feeding and watering the birds even though we are going to dispose of them eventually. We don't want them to just starve to death in the traps or die from neglect.

This past year I think was one of our most successful years of operation. During the entire summer, we did not receive one single call of damage to the grape vineyards. One inspector plus the student have been placed in charge of this operation. He has been working with the problem long enough that he can readily find the best and proper place to put the trap and also as soon as it becomes inactive or slows down, he moves the trap into other locations. It is very imperative that the man in charge of the operation of Starling control is completely knowledgeable of the subject so that he can move these traps and readily know where they will do the most good.

We have found that the proper placing of a trap can pull the Starlings in from a 5 mile radius within the area of the trap. By proper management and placing, the damage can be controlled.

We have also experimented with sound devices and have had varying success. We have tried the carbide guns and the exploding firecrackers; however, we have found in each case, especially with the zon guns, the birds become use to the noise and when the explosion occurs, they may rise but they settle immediately back down onto the grapes. With the exploding firecrackers, almost the same thing occurs. They do move when the firecracker goes off; however, they only move to another end of the field or within a few moments have settled back down on the grapes that they were feeding upon.

We have recently tried the Av-alarm system and have had excellent success. However, this last summer we placed the Av-alarm on 17 acres which was adjacent to the city of Santa Rosa. One day I received a phone call from the District Attorney informing me that he had a petition signed by surrounding residents complaining of noise pollution. We had to relocate the Av-alarm, turn it away from the houses which were close by, turn the volume down to as low as possible, but still maintain good control. As a result, the individual was still able to harvest almost a complete crop from that 17 acres of vineyard.

We intend to do more work with sound devices to make sure that they do work throughout the year. Although we have no feedlots in our County, we find that they are excellent for control of the birds during the feeding operations and this entire system seems very worthwhile and could prove very effective in the future.

At the present time, even though we are conducting a favorable program in our County for control of these birds, we realize that there is an awful lot of work yet to be done. We strongly recommend that different industries such as the Wine Institute, The Cherry Growers Association and related industries should provide grants to the University for continued study of the control of the Starling. Also, that there should be a ready supply of decoys available each spring when work is commenced. It is very difficult for a single county to maintain strong decoys throughout the winter. We have had excellent cooperation from the University of California at Davis in supplying us with excellent decoys to start our program each year.

I think also we need more research for roost control sprays where we may be able to go in and dispose of large numbers of these birds without endangering other types of species or the environment within the area. I realize that we will constantly and continually have problems from different environmental groups when we expose sprays or baits but the damage that these birds can do to the crops within the state of California are tremendous. We are going to have to put ourselves on the line to help our farmers so that they can still produce crops to make a living and feed the population.

When we look at the millions of birds that overwinter in California, we may think it is an impossible task to control them. We have found this is untrue so far. What the future may bring is hard to say; however, the trapping program in our County has proven very successful.

Our program in Sonoma County is going to definitely continue. We will use any method that is proven safe and satisfactory and again we must rely on the University of California for information and research. I cannot stress this strongly enough, that in all bird control work, continued research is an absolute must and control work is not easy but can be accomplished.